NATIONAL AEROSPACE STANDARD

NASM1312-18
STANDARD PRACTICE

FASTENER TEST METHODS

METHOD 18

ELEVATED TEMPERATURE

TENSILE STRENGTH

Aerospace Industries Association

THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MIL-STD-1312-18

DESIGNATION FOR THIS TEST METHOD REMAINS MIL-STD-1312-18

LIST OF CURRENT SHEETS									
NO.	1	2	3	4	5	6	7	8	9
REV.	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW
NO.	10	11	12	13	14	15	16	17	18
REV.	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW	NEW
NO.	19	20	21	23	24	25	26		
REV.	NEW	NEW	NEW	NEW	NEW	NEW	NEW		

FSC 53GP

APPROVAL DATE AUGUST 1997

FOREWORD

This standard sets forth standard test procedures for testing all types of structural fasteners in tension at elevated temperatures.

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FIGURES

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TABLE

1. SCOPE

1.1 Applicability. This test method outlines a procedure for testing all types of structural fasteners in tension at elevated temperatures. This procedure is intended to define the test required to determine the tensile strength of the fastener itself, not the strength of the fastener in any sheet combination.

1.2 For purposes of this test method, elevated temperatures are defined as being in the following classes:

Class	Temperature Range
I	250°F through 700°F
II	701°F through 1200°F
III	1201°F through 1800°F

2 REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards and handbooks. Unless otherwise specified, the following specifications, standards and handbooks of the issue listed in the current Department of Defense Index of Specifications and Standards (DoDISS) and the supplement thereto (if applicable), form a part of this standard to the extent specified herein.

STANDARD

MILITARY

MIL-STD-45662 Calibration System Requirements

(Copies of specifications, standards, handbooks, drawings and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) forms a part of this specification to the extent specified herein. The issues of the documents which are indicated as DOD adopted shall be the issue in the current DoDISS and the supplement thereto, if applicable.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

(Applicable for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 4	Load Verification of Testing Machines
ASTM E 83	Tentative Method of Verification and Classification of Extensometers
ASTM (Proposed)	Preparation of Thermocouple Measuring Junctions

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

3 DEFINITIONS

Not applicable.

4 GENERAL REQUIREMENTS

4.1 Test apparatus.

4.1.1 Testing machine. The testing machine shall be capable of applying a tensile load at a controlled rate. The calibration system for the machine shall conform to the requirements of MIL-STD-45662. Its accuracy shall be verified every 6 months by a method complying with ASTM E 4, using a calibration device calibrated by the National Bureau of Standards not more than 2 years before its use. The yield loads and structural failure loads of the fasteners tested (5.1.4 and 5.1.5) shall be within the loading range of the testing machine as defined in ASTM E 4.

4.1.2 Extension measuring device. The extension measuring device shall be an averaging differential transformer extensometer or equivalent preferably of the separable type. It shall conform to the requirements of Class B-2 in ASTM E 83 when used in conjunction with an autographic recorder. The extensometer shall be capable of installation so as to measure the extension of only the fastener. Load and extension ranges shall be used which give the initial portion of the load-extension curve a slope between 45 and 60 degrees.

4.1.3 Test fixtures. Fixtures shall be designed and fabricated to withstand the test loads without permanent deformation at the test temperature. Fixtures shall conform to all of the following provisions:

a. Hole size for installation formed fasteners shall be as specified in Figure 7. Where fastener type is not specified, the hole size shall be the maximum shank diameter of the fastener to be tested plus 0.001-inch (0.00254 cm) with a +0.004 -0.000-inch (+0.010 -0.000 cm) tolerance. Alternatively, the hole shall conform to the diameter and limits specified by the fastener manufacturer.

b. The hole shall be perpendicular to the fixture surfaces within 1 degree. When countersinking is required, the countersink shall be concentric with the hole within 0.002 FIM, and the depth shall be such that the installed fastener is not above flush.

c. Where applicable, the hole shall be chamfered or radiused to provide clearance for the head-to-shank fillet of the fastener.

d. The fixture shall be capable of applying an axial tensile load through the centerline of the fastener by means of suitable supporting fixtures.

4.1.3.1 Fixture construction. The recommended test fixture is the cup or insert type as defined and described in Figures 1 through 6. Hole sizes shall comply with Figure 7 if fastener is specified therein or 4.1.3a if fastener type is not covered in Figure 7. In any case the hole in the fixture shall not reduce the bearing area by more than 10 percent. The bearing area shall be considered as the area between minimum bearing face outer diameter and the maximum diameter at the point of tangency of the head-to-shank fillet. The fixture design shall provide clearance for the head-to-shank fillet.

4.1.3.2 Tension plate fixture. The tension plate type fixture may be used for short grip length fasteners. The fixture configuration shall be as shown on Figures 7 and 8 or Figures 9 and 10. The upper and lower plates shall be parallel within 0.25 degree.

4.1.3.3 Angularity. When tests evaluate the effect of angularity under the head or nut (collar) end of the fastener, the angularity shall be applied by the use of tapered spacers of the required angularity. The spacers shall be made of material as strong or stronger than the test fixture at the test temperature. The outside diameter of the spacer shall be greater than the head size of the fastener. Unless otherwise specified, the hole diameter shall be the maximum diameter of shank or thread whichever is greater plus 0.005-inch (0.0127 cm) with a +0.003 -0.000-inch (+0.0076 -0.000 cm) tolerance. The grip of the angle washer being used shall be measured at the centerline of the hole as shown in Figure 13.

CAUTION

Hole size shall take into consideration temperature expansion to prevent shearing of the fastener.

4.1.4 Furnace. The furnace construction is optional as long as requirements of this test method are met.

4.1.5 Controls. Controls and thermocouples used to indicate and control the temperature within the furnace shall be capable of determining, indicating and controlling the temperature within ±4 °F for Class I and within±5 °F for Classes II and III. Thermocouples are to be installed on the test specimen so as to indicate the temperature of the specimen and to exclude indications of the radiant heat from the furnace walls. Thermocouples shall meet ASTM (Proposed), Preparation of Thermocouple Measuring Junctions.

4.1.5.1 Thermocouples. Elevated test temperature must be sensed by thermocouples made from selected and calibrated wire certified by the producer. Wire gage is dictated by the temperature range and service life. However, the smallest diameter possible should be used in order to obtain reliable measurement in each range.

4.1.5.2 Thermocouple attachment and location. Thermocouples should be mechanically attached at the top, bottom, and center of the fastener except for relatively short fasteners where the center thermocouple may not be considered necessary or not possible to attach in order to maintain a constant record of temperature level and gradient throughout the testing period.

4.1.5.3 Gradient. The temperature gradient of specimens under test shall not exceed 10°F. Long specimens for which this gradient cannot be maintained may deviate from the 10°F gradient requirement. However, this deviation must be so noted prior to testing and in test reports.

4.2 Test specimens.

4.2.1 General. When specific bolt-nut combinations, pin and collar fasteners, or internally threaded fasteners supplied complete in one assembly are being evaluated, the tests shall be performed on the entire fastener assembly. Tests resulting in failure of any component of the assembly shall be considered a test of the fastener.

4.2.2 Externally threaded fasteners. The nut used for testing an externally threaded fastener shall be of sufficient strength to ensure externally threaded fastener failure. The nut portion can be an integral part of the test fixture. Tests resulting in nut failure shall not be considered a valid test of the bolt.

4.2.3 Internally threaded fasteners. The bolt used for testing an internally threaded fastener shall be of sufficient strength to ensure internally threaded fastener failure. The bolt portion can be an integral part of the test fixture. Tests resulting in bolt failure shall not be considered a valid test of the nut.

4.2.4 Grip length.

4.2.4.1 Fasteners having a specific grip range (such as lockbolts, hi-shear pins, blind rivets, and blind bolts) shall be tested in such grip conditions as required by applicable specifications or procurement documents.

4.2.4.2 Threaded fasteners having no specified grip range shall be tested at the grip length where two to three bolt threads (complete and incomplete) extend below the bearing face of the nut. The incomplete threads should extend beyond the top of the nut.

4.2.4.3 The grip length of the test fixture for fasteners which are installed with installation preload shall be adjusted with washers or shims located between the test fixtures, not under nuts, collars, or heads.

4.2.5 Washer or spacers. The use of washers under fastener heads, nuts, or collars is prohibited unless the use of such washers is required in the production application.

4.2.6 Preload. Unless otherwise specified, fasteners that normally exert tension preload shall have that preload released prior to testing. Preload may be released by the melting of a Cerrolow spacer or equivalent.

5. DETAIL REQUIREMENTS

5.1 Test procedures.

5.1.1 Test setup.

5.1.1.1 Assembly. The specimen shall be installed in the holding fixture at the proper grip using normal installation procedures. Preload shall not be used except on those fasteners where preload is necessary to maintain structural integrity of fastener. The assembly of specimen and fixtures shall be placed between the machine tension heads.

5.1.1.2 Tension plate fixture. The specimens shall be installed in the fixture at the proper grip using normal installation procedures. Preload shall not be used except for those fasteners where preload is necessary to maintain structural integrity of fastener. The assembly of specimen and plates shall be installed in a suitable testing as shown on Figures 8 and 10 and placed between the compression heads of the testing machine. Care shall be exercised to locate the jig at the center of the piston when hydraulic testing machines are used.

5.1.2 Loading rate. Tension load shall be applied to the fastener slowly and evenly. Unless otherwise specified by the fastener manufacturer or by applicable detail specification or procurement document, the rate of loading shall be in accordance with Table I. Larger or smaller fasteners than those shown in Table I shall be tested at rates producing 100,000 pounds per minute (±10 percent) per square inch of nominal shank area.

TABLE I. Tension load rates.

Nominal fastener diameter	Load rate lb/min (kg/min)	Nominal fastener diameter	Load rate lb/min (kg/min)
0.125	1,240 (562)	0.563	24,800 (11,200)
0.156	1,920 (871)	0.625	30,600 (13,900)
0.164	2,100 (953)	0.750	44,000 (19,900)
0.190	2,800 (1270)	0.875	60,000 (27,200)
0.250	5,000 (2270)	1.000	78,000 (35,400)
0.313	7,700 (3490)	1.125	100,000 (45,400)
0.375	11,000 (4990)	1.250	122,000 (55,300)
0.438	15,000 (6800)	1.375	148,000 (67,100)
0.500	19,600 (8890)	1.500	176,000 (79,800)

NOTE: As an alternate loading method, the rate of loading can be determined as a constant head travel that gives strain rates consistent with the above load rates in the elastic range.

CAUTION

When loading, assure that lag between actual and indicator has been taken into account.

5.1.3 Load-deflection curves. Load-deflection curves shall be made by autographic recording. The extensometer shall be so installed as to measure the deflection of the fastener only. This measurement shall be accomplished by placing the extensometer adjacent to the fastener between the facing surfaces of the fastener holding fixtures per Figures 1 through 6 or on the external opposed surfaces of the tension plate. The fixture shall have the capability of withstanding the ultimate load without yielding.

5.1.4 Structural failing load determination. When a structure failure occurs before the ultimate or fracture load, it may be detected on the load-deflection curve as a peak load followed by severe permanent deformation without increase in load or with a decrease in load. A sample load-deflection curve illustrating a "structural failure" is shown on Figure 11. The first peak load shall be designated as the "structural failure load" and the highest peak shall be the "ultimate" load.

5.1.5 Yield load determination. The yield load shall be determined by the Johnson two-thirds approximate method as shown on Figure 12. On the load-deflection plot of 5.1.3, draw a line with two-thirds the slope of the elastic portion of the curve. Parallel to this line and tangent to the load-deflection curve, draw another line. The point of tangency represents the yield load.

5.1.6 Temperature. The maximum time for heating the specimens to temperature shall be specified in the procurement document. The minimum time shall be 60 minutes per inch of specimen diameter. Unless otherwise specified, the test setup shall be maintained at the test temperature 30 minutes prior to load application and throughout the test load application. Do not heat the specimen to a temperature higher than the test temperature.

6. NOTES

6.1 Test report. The test report shall include the following data:

a. Fastener description.

1. Part number.
2. Lot identification.
3. Material.
4. Heat treat.
5. Grip length.
6. Mating part.
7. Measured fastener diameter.

b. Test machine.

1. Model and serial number.

2. Calibration date.

c. Extensometer and gage length.

d. Yield load.

e. Ultimate load.

f. Structural failure load.

g. Load-deflection curve.

h. Installation procedure.

i. Test method (where options are available).

j. Test load and load rate.

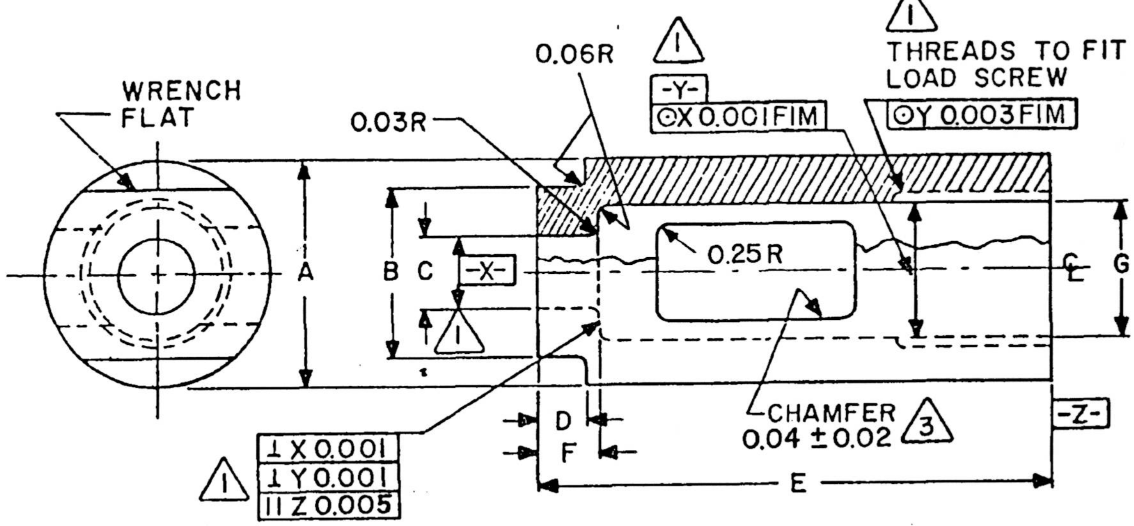
k. Type of failure.

l. Temperature reading.

m. Results of all inspection.

n. Specimen preparation.

o. Type of heat used.



Fixture numbers	Fastener diameter	A ±0.010	B ±0.005	C ±0.0005	D ±0.031	F +0.031 -0.000	G +0.010 -0.000
1	From 0.188 through 0.375	2.250	1.750	0.6250	0.500	0.375	1.020
2	Over 0.375 through 0.625	2.240	1.750	0.8800	0.500	0.500	1.270
3	Over 0.625 through 1.000	4.500	4.000	1.2550	0.500	0.750	1.937
4	Over 1.000 through 1.500	5.562	5.062	2.0050	0.500	1.125	2.750

NOTES:

1. Standardized portion of adapter mandatory design requirement.
2. Recommend design for the adapter may be varied as necessary to fit various machines except that concentricity and perpendicularity must be maintained. Total length of dimension E dependent upon type of machine and fastener configuration.
3. Window recommended to facilitate installation and removal of the specimens.
4. All sharp corners shall be chamfered.
5. Overall finish requirement: 63 microinches or better (1 Figure 7).
6. Material and heat treat: See paragraph 4.1.3.

FIGURE 1. Standard test holding fixture for insert type adapters.

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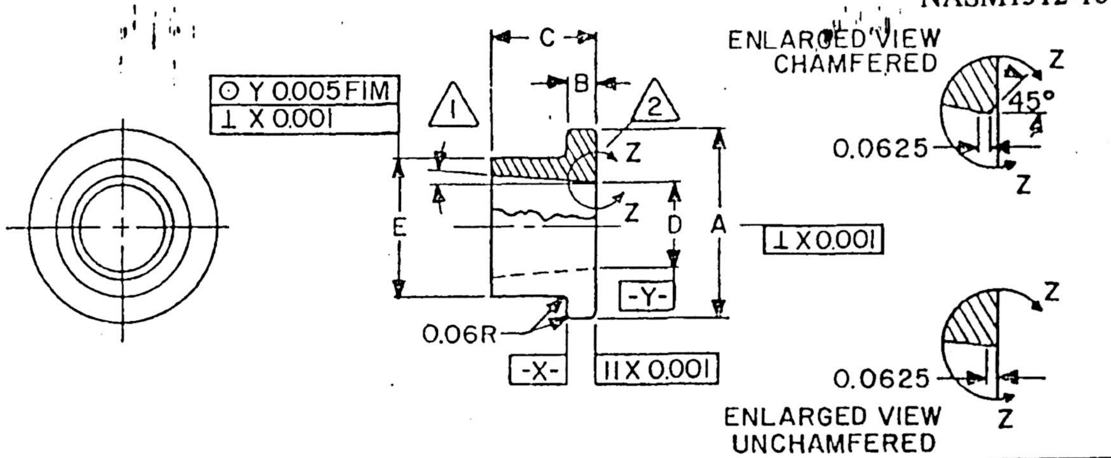
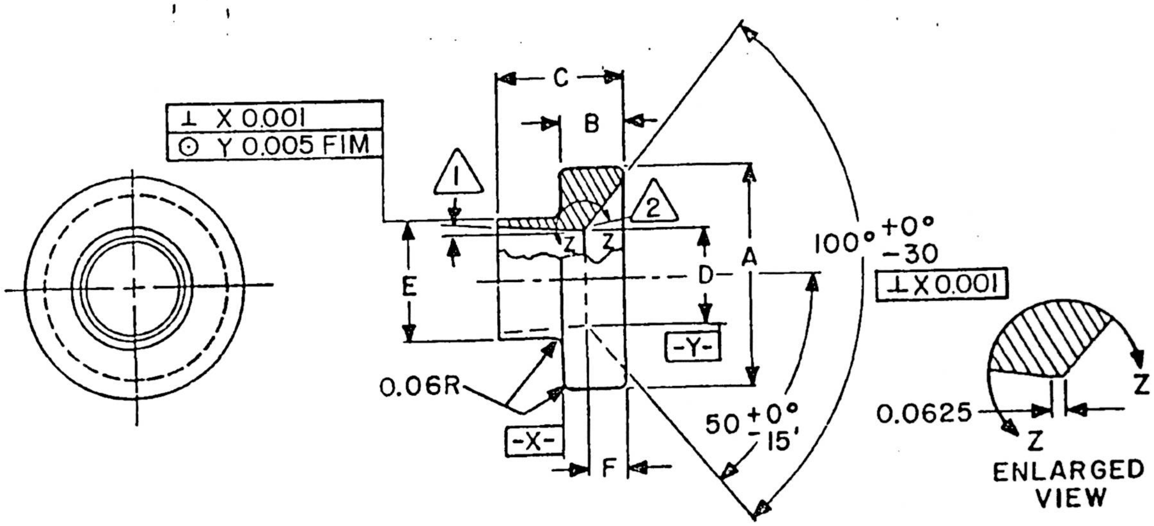


Nominal fastener diameter	A +0.000 -0.006	B ±0.005	C ±0.030	D	E ±0.0005	F ±0.005	Shortest grip length possible to test: Without washer	With washer
0.190	1.000	0.1875	0.5625	0.194 - 0.190	0.6235	0.307	1.125	1.209
0.250	1.000	0.1875	0.5625	0.254 - 0.250	0.6235	0.339	1.125	1.209
0.313	1.000	0.1875	0.5625	0.3165 - 0.3125	0.6235	0.401	1.125	1.209
0.375	1.000	0.3750	0.750	0.379 - 0.375	0.6235	0.489	1.500	1.584
0.438	1.250	0.3750	0.875	0.4410 - 0.4375	0.8785	0.550	1.750	1.834
0.500	1.250	0.3750	0.875	0.504 - 0.500	0.8785	0.612	1.750	1.834
0.563	1.250	0.3750	0.875	0.5680 - 0.5625	0.8785	0.677	1.750	1.834
0.625	1.250	0.3750	0.875	0.630 - 0.625	0.8785	0.775	1.750	1.834
0.750	1.6875	0.6250	1.375	0.755 - 0.750	1.2535	0.900	2.740	2.824
0.875	1.6875	0.6250	1.375	0.882 - 0.875	1.2535	1.025	2.740	2.856
1.000	1.6875	0.6250	1.375	1.010 - 1.00	1.2535	1.150	2.740	2.856
1.125	2.5625	1.000	2.125	1.135 - 1.125	2.0035	1.275	4.250	4.366
1.250	2.5625	1.000	2.125	1.260 - 1.250	2.0035	1.437	4.250	4.366
1.375	2.5625	1.000	2.125	1.385 - 1.375	2.0035	1.562	4.250	4.366
1.500	2.5625	1.000	2.125	1.510 - 1.500	2.0035	1.687	4.250	4.366

NOTES:

1. Taper from top to bottom with standard 0.250-inch per foot taper equipment.
2. This chamfer to be 45° x F diameter for applicable test fastener sizes. This chamfer is required only on the head end of the fastener and may be omitted if washer is used.
3. Finish: 63 microinches or better. Unplated. The application of corrosion preventive oil is recommended (1 Figure 7).
4. Chamfer all sharp corners.
5. Material and heat treat: See paragraph 4.1.3
6. If it is necessary to test fasteners with shorter grip lengths than can be accommodated by this adapter, the adapter shown in Figure 5 shall be used.

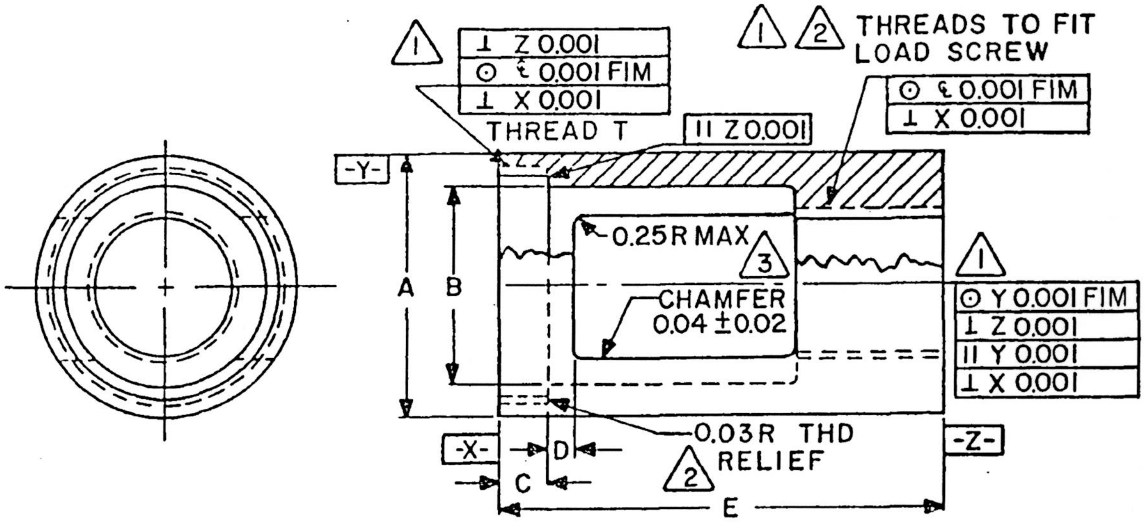
FIGURE 2. Insert type adapter for protruding head fasteners.



Nominal fastener diameter	A +0.000 -0.006	B ±0.010	C ±0.010	D	E ±0.0005	F ±0.005	Shortest grip length possible to test
0.190	1.000	0.2675	0.5475	0.194 - 0.190	0.6235	0.080	1.110
0.250	1.000	0.2935	0.6685	0.254 - 0.250	0.6235	0.106	1.231
0.313	1.000	0.3205	0.6955	0.3165 - 0.3125	0.6235	0.133	1.258
0.375	1.000	0.4725	0.8475	0.379 - 0.375	0.6235	0.160	1.598
0.438	1.250	0.5005	0.9725	0.4410 - 0.4375	0.8785	0.188	1.848
0.500	1.250	0.5275	1.0275	0.504 - 0.500	0.8785	0.215	1.903
0.563	1.250	0.5545	1.0545	0.5680 - 0.5625	0.8785	0.242	1.930
0.625	1.250	0.5825	1.0825	0.630 - 0.625	0.8785	0.270	1.958

NOTES:
1. Taper from top to bottom with standard 0.250-inch per foot taper equipment.
2. Radius at F dimension to be slightly larger than that of test specimen.
3. Finish: 63 microinches or better. Unplated. The application of corrosion preventive oil is recommended (1 Figure 7).
4. Chamfer all sharp corners.
5. Material and heat treat: See paragraph 4.1.3.
6. If it is necessary to test fasteners with shorter grip lengths than can be accommodated by this adapter, the adapter shown in Figure 6 shall be used.

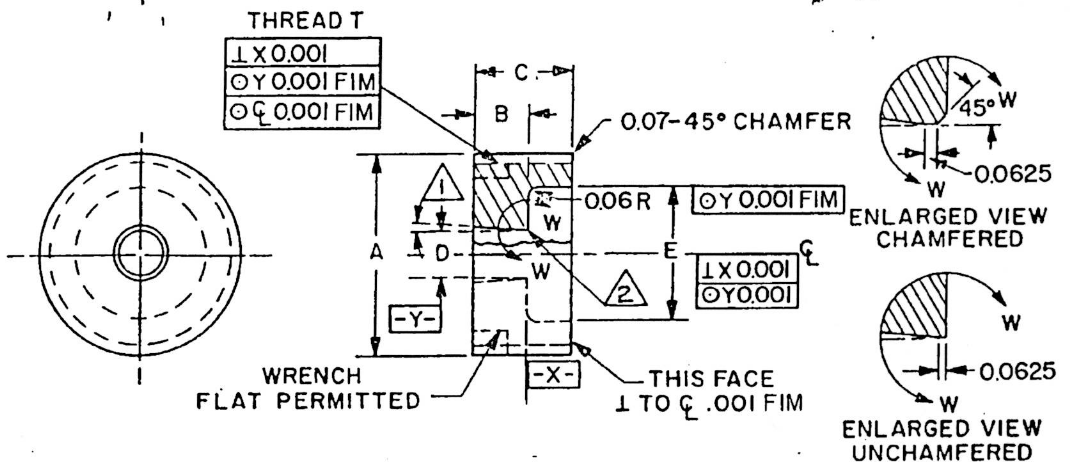
FIGURE 3. Insert type adapter for flush head fasteners.



Fixture number	Fastener diameter	A ±0.010	B ±0.010	C ±0.005	D ±0.010	T
1	.190 through 0.375	2.700	2.000	0.500	0.250	2 1/4-12NF2
2	Over 0.375 through 0.625	3.200	2.000	0.750	0.250	2 1/4-12NF2
3	Over 0.625 through 1.000	3.700	2.500	1.000	0.375	3 -12NF2
4	Over 1.000 through 1.500	5.000	3.500	1.250	0.500	4 -12NF2

NOTES:
1. Standardized portion of adapter mandatory design requirement.
2. Recommended design for the adapter may be varied as necessary to fit various machines except that concentricity and perpendicularity must be maintained. Total length of dimension E dependent upon type of machine and fastener configuration.
3. Window recommended to facilitate installation and removal of test specimens.
4. All sharp corners shall be chamfered.
5. Overall finish requirements: 63 microinches or better (1 Figure 7).
6. Material and heat treat: See paragraph 4.1.3.
7. This fixture is intended for use with Figure 5 and Figure 6 cup type adapters.

FIGURE 4. Standard test holding fixture for cup type adapter.

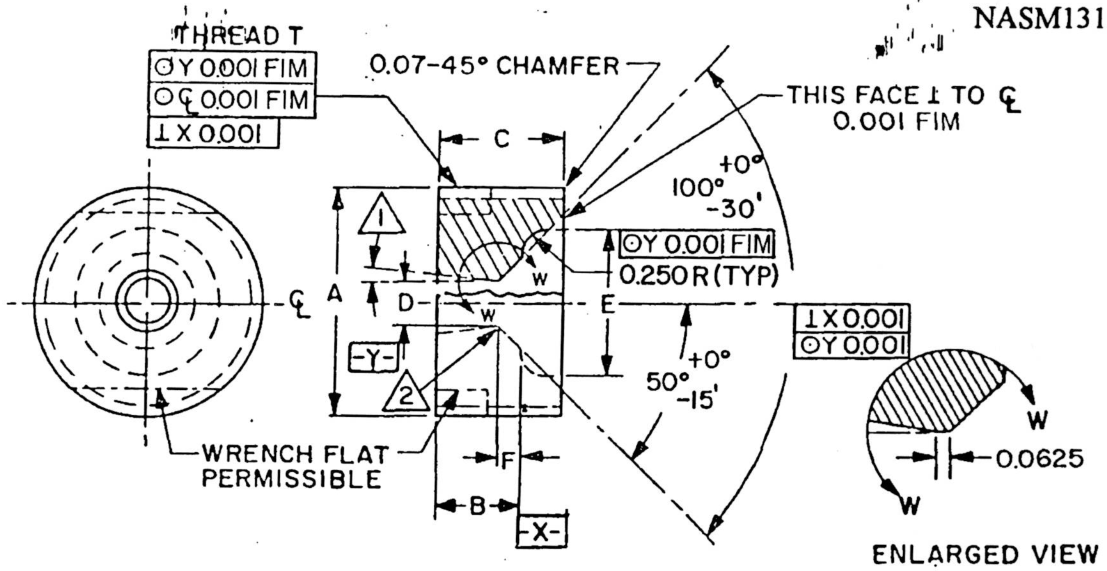


Nominal fastener diameter	A ±0.030	B ±0.005	C ±0.010	D	E ±0.010	F ±0.005	T
0.190	2.250	0.300	1.125	0.194 - 0.190	1.500	0.307	2 1/4-12NF2
0.250	2.250	0.400	1.125	0.254 - 0.250	1.500	0.339	2 1/4-12NF2
0.313	2.250	0.425	1.125	0.3165 - 0.3125	1.500	0.401	2 1/4-12NF2
0.375	2.250	0.450	1.125	0.379 - 0.375	1.500	0.489	2 1/4-12NF2
0.438	2.250	0.500	1.125	0.4410 - 0.4375	1.500	0.550	2 1/4-12NF2
0.500	2.250	0.600	1.125	0.504 - 0.500	1.500	0.612	2 1/4-12NF2
0.563	2.250	0.700	1.125	0.5680 - 0.5625	1.500	0.677	2 1/4-12NF2
0.625	2.250	0.800	1.125	0.630 - 0.625	1.500	0.775	2 1/4-12NF2
0.750	3.000	0.975	1.750	0.755 - 0.750	2.250	0.900	3 -12NF2
0.875	3.000	1.150	1.750	0.882 - 0.875	2.250	1.025	3 -12NF2
1.000	3.000	1.300	1.750	1.010 - 1.000	2.250	1.150	3 -12NF2
1.125	4.000	1.450	2.500	1.135 - 1.125	2.750	1.275	4 -12NF2
1.250	4.000	1.630	2.500	1.260 - 1.250	2.750	1.437	4 -12NF2
1.375	4.000	1.750	2.500	1.385 - 1.375	2.750	1.562	4 -12NF2
1.500	4.000	1.950	2.500	1.510 - 1.500	2.750	1.687	4 -12NF2

NOTES:

1. Taper from top to bottom with standard 0.250-inch per foot taper equipment.
2. This chamfer to be 45° x F diameter for applicable test fastener sizes. This chamfer is required only on the head end of the fastener and may be omitted if washer is used.
3. Finish: 63 microinches or better. Unplated. The application of corrosion preventive oil is recommended (1 Figure 7).
4. Chamfer all sharp corners.
5. Material and heat treat: See paragraph 4.1.3.

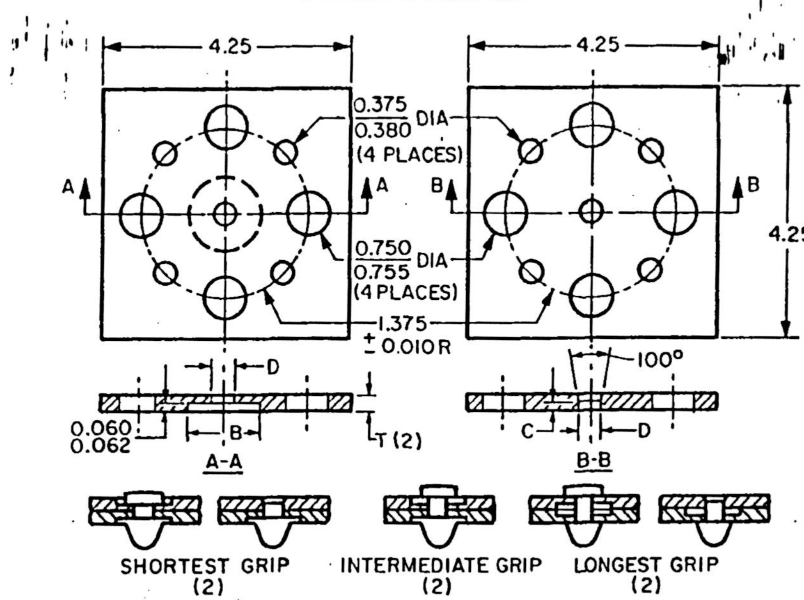
FIGURE 5. Cup type adapter for protruding head fasteners.



Nominal fastener diameter	A ±0.003	B ±0.005	C ±0.010	D	E ±0.010	T	F ±0.005
0.190	2.250	0.300	1.125	0.194 - 0.190	1.500	2.250-12NF2	0.080
0.250	2.250	0.400	1.250	0.254 - 0.250	1.500	2.250-12NF2	0.106
0.313	2.250	0.425	1.250	0.3165 - 0.3125	1.500	2.250-12NF2	0.133
0.375	2.250	0.450	1.275	0.379 - 0.375	1.500	2.250-12NF2	0.160
0.438	2.250	0.500	1.300	0.4410 - 0.4375	1.500	2.250-12NF2	0.188
0.500	2.250	0.600	1.325	0.504 - 0.500	1.500	2.250-12NF2	0.215
0.563	2.250	0.700	1.350	0.5680 - 0.5625	1.500	2.250-12NF2	0.242
0.625	2.250	0.800	1.375	0.630 - 0.625	1.500	2.250-12NF2	0.270

NOTES:
1. Taper from top to bottom with standard 0.250-inch per foot taper equipment.
2. Radius at F dimension to be slightly larger than that of test specimen.
3. Finish: 63 microinches or better. Unplated. The application of corrosion preventive oil is recommended (△1 Figure 7).
4. Chamfer all sharp corners.
5. Material and heat treat: See paragraph 4.1.3.

FIGURE 6. Cup type adapter for flush head fasteners.



Nom fstnr size	T +0.001 -0.000 (in.)	B dia ±0.01 (in.)	D diameter, +0.004, -0.000 (in.)					C dimension, +0.000, -0.002 (in.)					
			(a,b, c,d)	(e)	(f)	(g)	(h)	(a)	(b,g)	(c,h)	(d)	(e)	(f)
0.093	0.125	0.75	0.094			0.097			0.036				
0.125	0.125	0.75	0.125			0.129			0.042		0.030		
0.156	0.188	0.88	0.156	0.164	0.170	0.160			0.055		0.038	0.072	0.070
0.164	0.188	0.88	0.165					0.072					
0.190	0.250	1.00	0.190	0.199	0.197	0.192	0.190	0.084	0.070	0.048	0.046	0.084	0.080
0.190	0.250	1.00	0.190	0.199	0.197			0.084	0.070	0.048		0.084	0.080
0.250	0.250	1.00	0.250	0.261	0.258	0.256	0.260	0.110	0.095	0.063	0.061	0.111	0.108
0.313	0.250	1.12	0.312	0.313	0.339			0.138	0.106	0.070		0.139	0.128
0.375	0.250	1.12	0.375	0.375	0.391			0.159	0.134	0.081		0.167	0.160

(a) Protruding and flush tension head solid shank fasteners
(b) Flush MS20426 head solid shank fasteners
(c) Flush head solid shank fasteners
(d) Flush shear head driven rivets
(e) Jo-Bolts
(f) Blind bolts
(g) Blind rivets except Deutsch
(h) Deutsch blind rivets

Tolerances: ±0.010 and ±1°, unless otherwise indicated chamfer all hole edges to provide head fillet clearance.

NOTES:
1. Surface finish 32 to 63 per ANSI B46.1.
2. Counterbore optional, if short and intermediate grips are not required.

FIGURE 7. Tension fixtures for short grip fasteners.

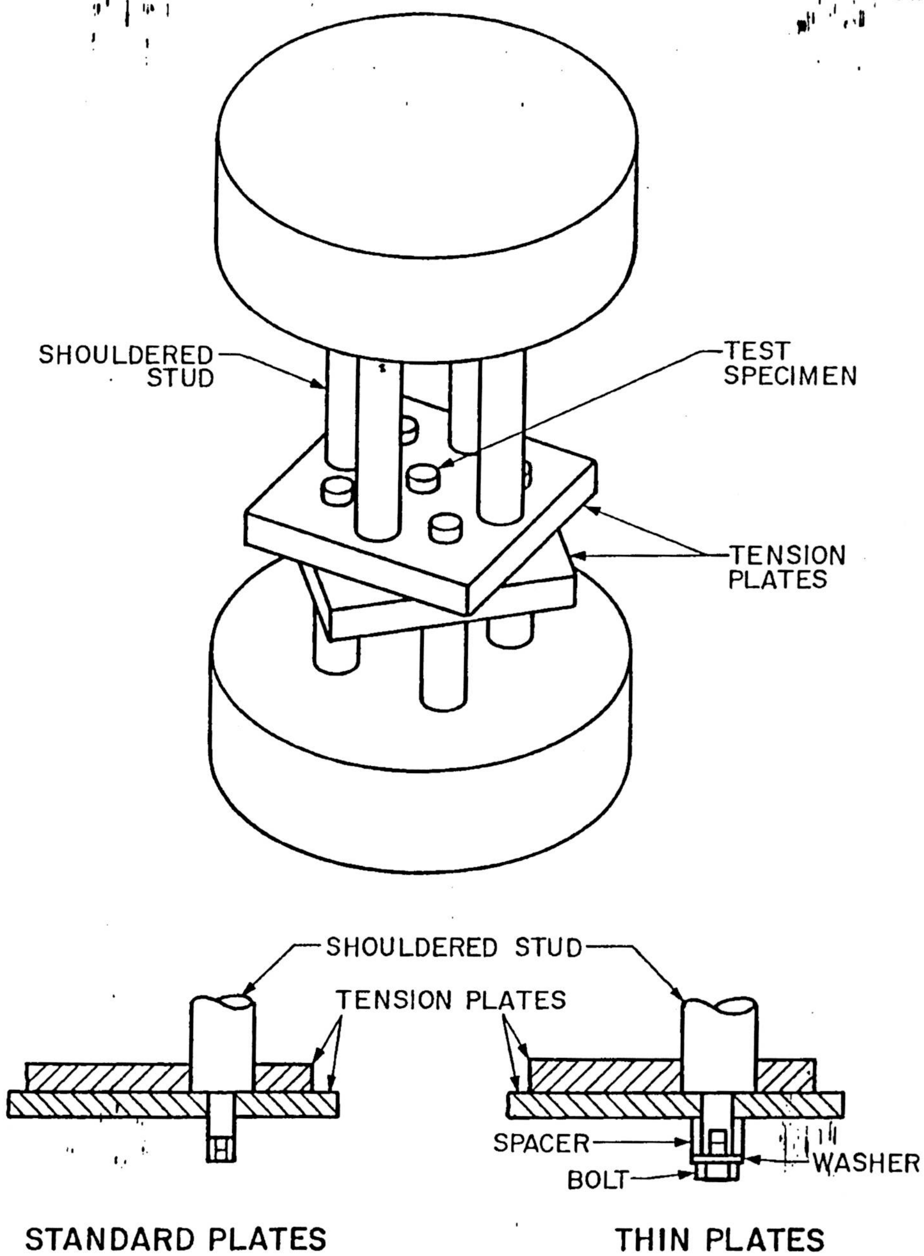
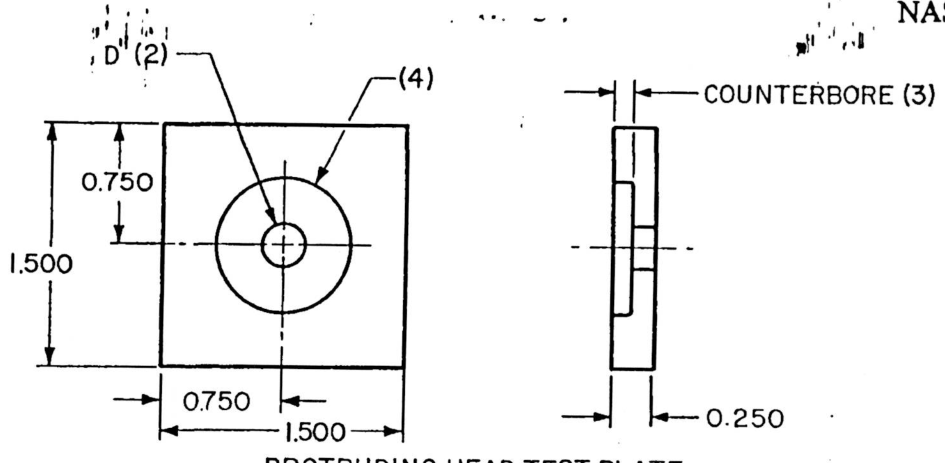
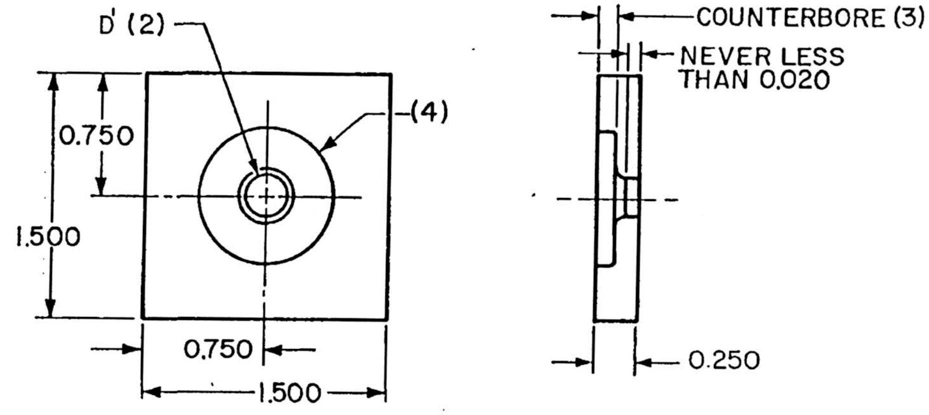


FIGURE 8. Tension setup.



PROTRUDING HEAD TEST PLATE



FLUSH HEAD TEST PLATE

NOTES:

1. Machine or grind edges square with face (see Figure 7).
2. D^1 = (D +0.001), +.004, -.000 where D equals the fastener max shank diameter.
3. Counterbore as required for grip.
4. Diameter to clear fastener.

FIGURE 9. Test plate.

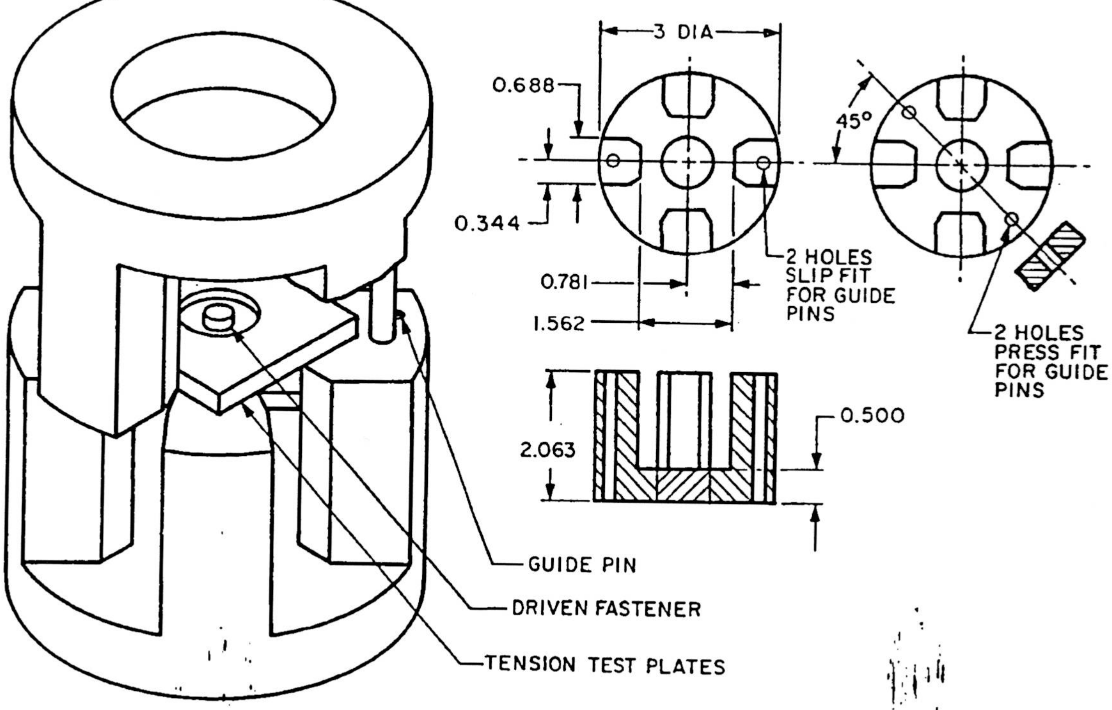


FIGURE 10. Tension fixture assembly.

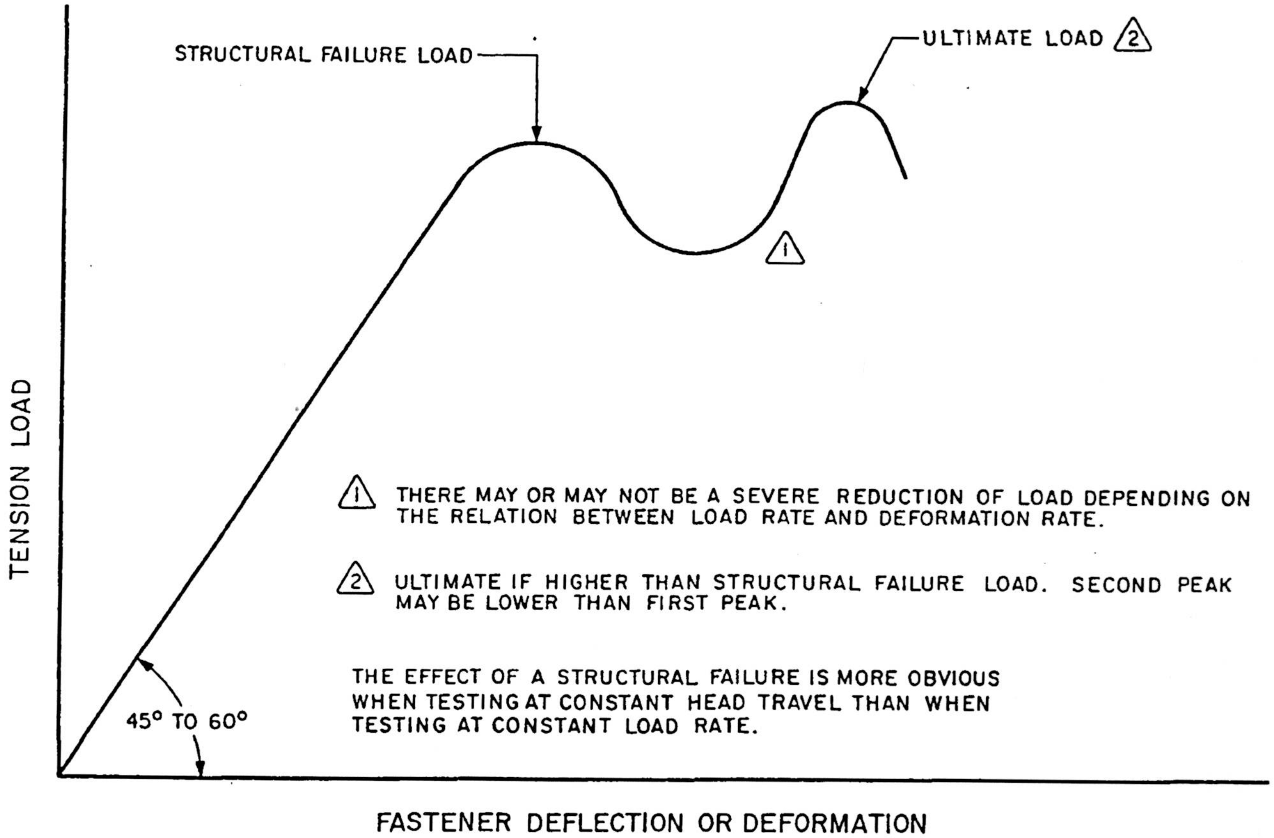


FIGURE 11. Sample load-deflection curve.

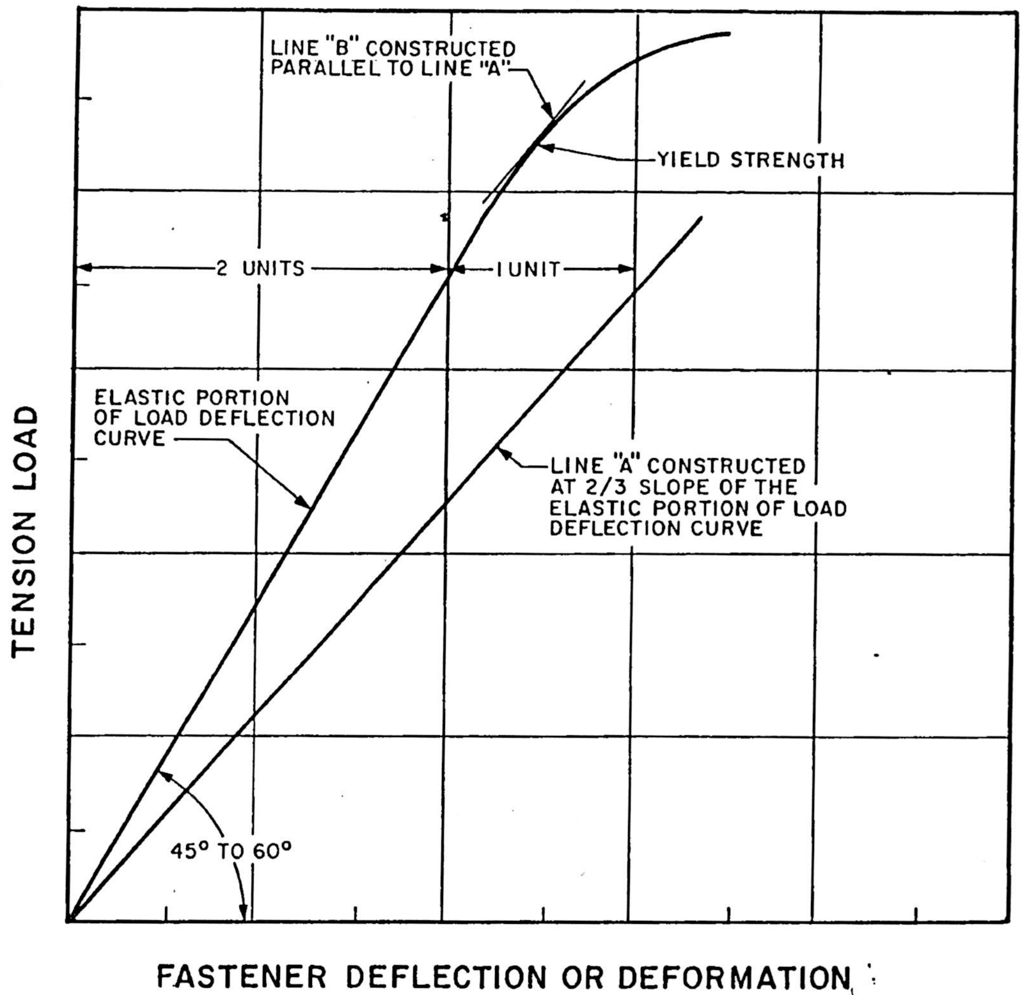


FIGURE 12. Johnson's two-thirds approximate method for determination of yield strength.

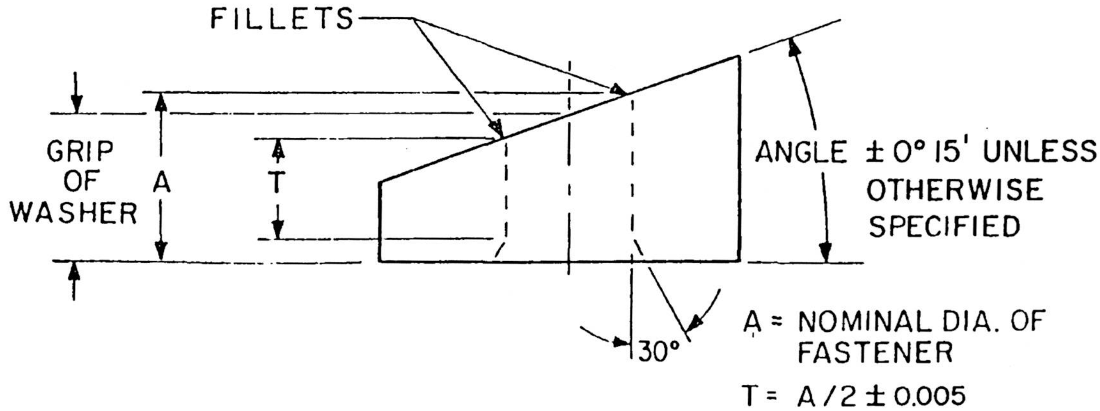


FIGURE 13. Grip measurement on angle washer.